TOYOTA
INDUSTRIAL EQUIPMENT

Service Manual

7BPUE15

Serial Numbers
80,001 and up

Manual Design

This Service Manual is designed with the following objectives in mind:

- Provide technical coverage for expected levels of user expertise.
- Anticipate your needs and reduce your decisions regarding maintenance.
- Reduce page flipping through a "one-stop shopping" approach.

The two-line running page header at the top of each page tells you:

- Name of the manual (OrderpickerModel *7BPUE15* Service Manual)
- Current Chapter Title (e.g., this page How to Use ***This*** Manual)
- Current topic (e.g., this page Manual Design)

We suggest turning to the **START** page first when you use this manual.

The **START** page asks a few simple questions to guide you to the proper chapter.

- **How to Use This Manual** explains the manual format and design and contains the Table of Contents and START page.
- **Safety** explains warning and caution notes, general safety rules and safety rules for batteries, static, jacking, and welding.
- **Systems Overview** includes truck dimensions and specifications.
- **Planned Maintenance** outlines the recommended schedule of preventive services to keep your truck working most efficiently.
- **Troubleshooting** is a set of "decision-tree" charts designed to take you from a symptom to a specific sequence of tests in order to isolate a failing component.
  - The **START TROUBLESHOOTING** chart (on Page 5-27) will guide you to the individual troubleshooting symptom chart you need.
  - Once you're familiar with the symptoms listed, you may instead simply find the symptom chart from the **Troubleshooting Flowcharts** (Page 5-27).
  - When you complete a troubleshooting procedure, be sure to follow the steps in **End of Troubleshooting Chart END-1** (Page 5-28).
- **Codes and Tests** lists the electrical fault codes and procedures for running firmware electrical tests.
- **Component Procedures** gives step-by-step procedures for testing, removal, installation, and adjustment of individual truck components. Components are grouped by truck system.

  To find a component procedure, you may use one of three methods:
  - Look up the component name in the List of **Component Procedures** (Page 7-1).
  - Find the component in the **Component Locator Photos** (Page 7-5).
  - Look up the component name in the Service Manual **Index** (Page I-1).
- **Theory of Operations** explains signal flow within hydraulic and electrical schematics for various conditions of truck operation.
- **Appendix** contains reference information such as torque values, lubrication specifications, and system schematics.
- **Index** lists subjects alphabetically.

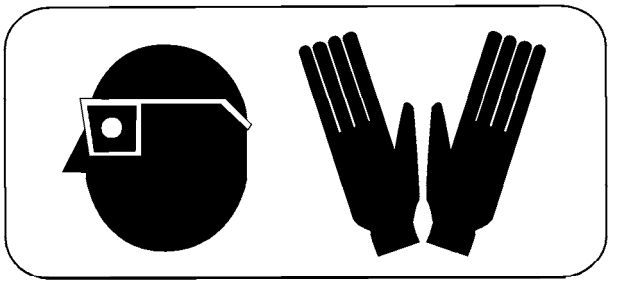
Battery Safety

⚠ WARNING

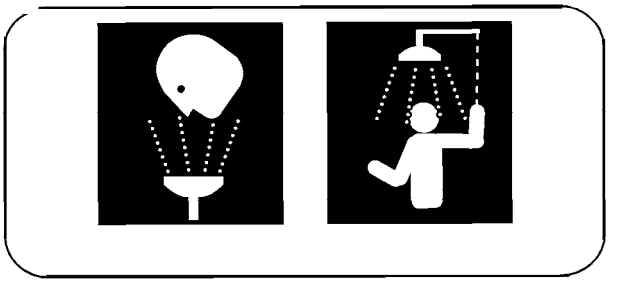
As a battery is being charged, an explosive gas mixture forms within and around each cell. If the area is not properly ventilated, this explosive gas can remain in or around the **battery** for several hours after charging. Be sure there are no open flames or sparks in the charging area. An open flame or spark can ignite this gas, resulting in serious damage or injury.

⚠ WARNING

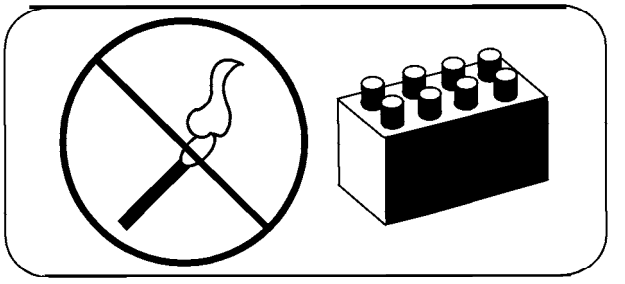
Battery electrolyte is a solution of sulfuric acid and water. Battery acid causes burns. Should any electrolyte come in contact with your clothing or skin, flush the area immediately with cold water. Should the solution get on your face or in your eyes, flush the area with cold water and get medical help immediately.



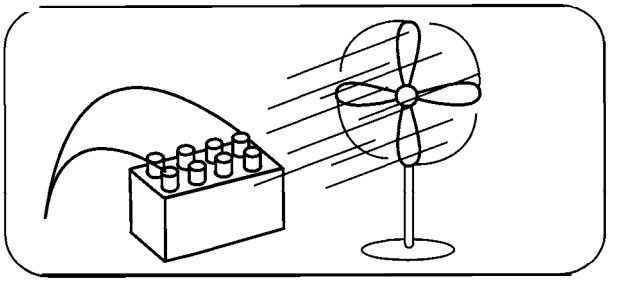
Wear personal protective equipment to protect eyes, face and skin when checking, handling or filling batteries. This equipment includes goggles or face shield, rubber gloves (with or without arm shields) and a rubber apron.



Make sure a shower and eyewash station are nearby in case there is an accident.



A battery gives off explosive gases. NEVER smoke, use an open flame, or use anything that gives off sparks near a battery.



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Cold Storage Schematic Legend	
Identification	**Description**
TH2	Thermostat for tractor heaters (above steer/tractor manager)
TH3	Thermostat for control handle heater

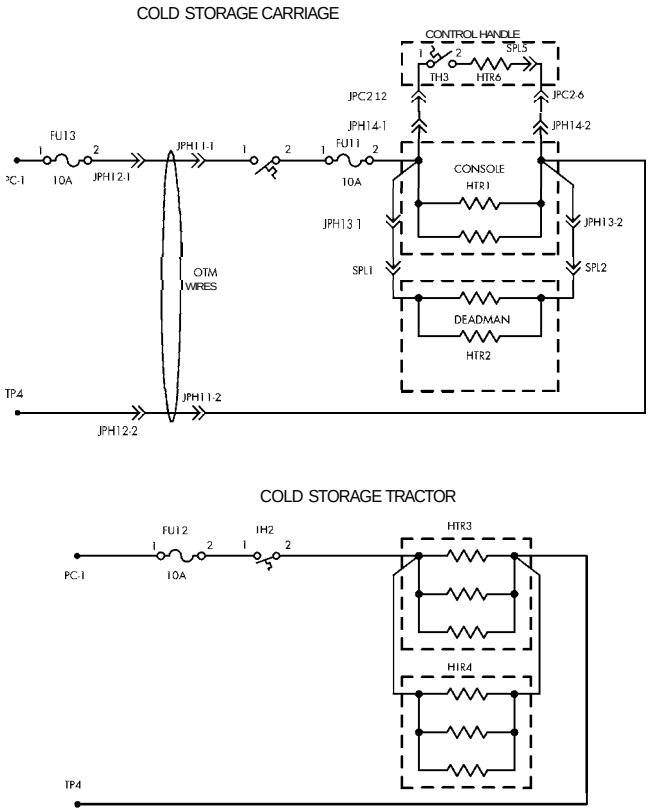

Figure 3-3. Cold Storage Electrical Schematic

Interval 3

Moderate and Severe Usage: Every Year or 1500 Operating Hours		
Component	**What to do**	**Refer to**
Hardware	Tighten or replace any loose, broken or missing hardware.	
Drive Unit	Change the fluid in the drive unit.	Page A-2
Hydraulic System	Replace the hydraulic fluid and filter.	Page 7-60 Page A-2

Switches (General)

Test/Inspection

Examine the switch for signs of arcing, overheating, discoloration, cracking, or other physical damage. Replace the switch if you see such damage.

To test a switch, isolate it from the electrical circuit. Do this by removing all the connections from the switch, making sure all wires are labeled and identified for reconnection.

Use an ohmmeter set to a low resistance scale to measure the resistance across the switch. In a closed position, the switch should be less than 1 ohm. In an open position, the switch should show a resistance greater than 10 megohms.

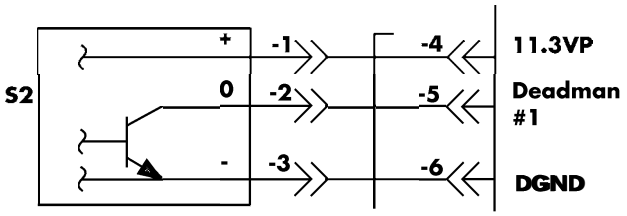

Figure 5-1. Hall Effect Switch Schematic

Hall Effect Switches

The limit switches and deadman switches used on this truck are Hall Effect switches. These switches consist of a transistor that is turned on when a magnet is positioned next to the base. (Keep in mind that the magnet is part of the switch assembly and can only be seen if the switch is disassembled.)

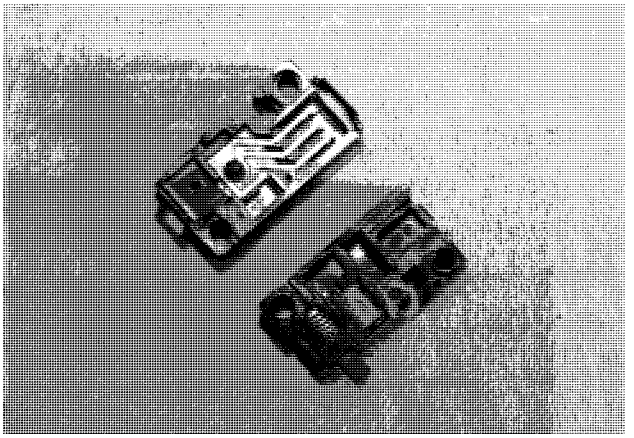

Figure 5-2. Typical Hall Effect Switch

The switch is powered as follows:

- +6 to +12 volts is applied to the positive (+) terminal.
- Battery negative is applied to the negative (-) terminal.

As shown in Figure 5-1, when a magnet is not present, the transistor is OFF and the output lead (Deadman #1) is in a high state.

When a magnet is present, the transistor is turned ON creating a path from the DGND (-) terminal to the Deadman #1 terminal. Terminal Deadman #1 will now be a negative (-) potential, or active.

Key Switch

Inspection

With the battery plugged in and key switch in the ON position, battery voltage B+ should be present on both terminals of the switch. Test the key switch with an ohmmeter after removing it from the electrical system. In the OFF position, the ohmmeter should read greater than 10 megohms, and in the ON position, the ohmmeter should read less than 1 ohm. If not, replace the switch.

Programmable Maintenance Tool

Figure 5-4. Programmable Maintenance Tool

The optional Programmable Maintenance Tool (PMT)(P/N 00590-49981-71) allows you to test and diagnose the traction power amplifier in this lift truck.

The PMT is powered by the host amplifier through the four-pin connector on the amplifier. See Figure 5-5.

When the PMT is first plugged into the amplifier, the PMT displays the amplifier's model number, date of manufacture, and software revision code. Following this initial display, the PMT displays a prompt for further instruction.

NOTE: Follow the prompt at the top of the PMT screen, not the blinking icon, to choose the correct setting.

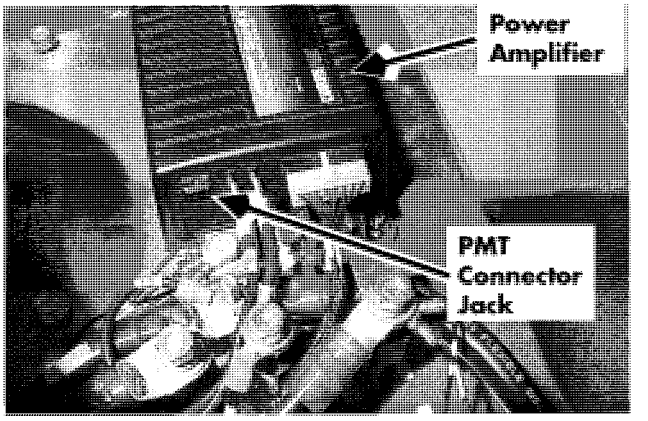

Figure 5-5. Connection for PMT to Traction Power Amp

Diagnostic History

You can use the Programmable Maintenance Tool to access the diagnostic history file of the traction power amplifier.

The PMT will read out all the faults that the amplifier has experienced since the last time the diagnostic history file was cleared. The faults may be intermittent faults, faults caused by loose wires, or faults caused by operator error.

For example, an overtemperature fault may be caused by operator habit or overloading.

NOTE: Each fault is listed only once, regardless of the number of times it occurred.

Access

1. Turn the key switch OFF and disconnect the battery connector.
2. Remove the tractor cover.
3. Connect the PMT to the traction power amplifier.
4. Connect the battery and turn the key switch ON.
5. Hold the more info key, and press the diagnostics key.

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Traction Power Amplifier Fault Codes

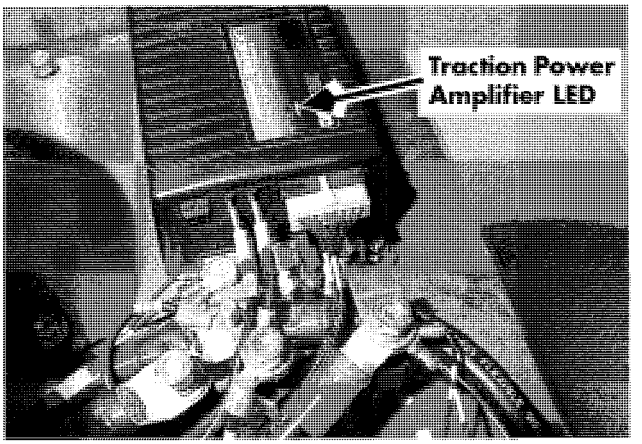

Figure 6-3. Traction Power Amplifier

An internal microcontroller automatically checks the function of the traction power amplifier. When this microcontroller detects a fault, it signals the appropriate fault code through the light emitting diode (LED)on the front of the traction power amplifier. These are **not** the codes that appear on the operator display and tractor manager.

Under normal operation, the LED flashes a single flash at approximately one flash per second (a "heartbeat" indicator). A two-digit flash code signals the power amplifier has detected a fault within itself. The code continues flashing until corrected.

TPA Code LED Off

Code Title	**No power or defective amplifier**
Reason	Amplifier has no power or is bad. **Check cable** at power amplifier
System Response	System shutdown, lowering enabled
Alarm Sounds	No
TPA LED Display	●
PC Contactor	Open
Speed Limit	0 mph
How to Clear	Replace or repair bad component

Corrective Actions and Checks

Step	Action/ Meter Setting	(+) Lead	(–) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPT11-10	B- cable at TPA	B+	Step 2	Replace STM
2	DCV	51-16	B- cable at TPA	B+	Replace TPA	Troubleshoot wire from STM

Code 1,3

Code Title	Lift contactor detected closed when commanded open
Reason	The P sense line (JPT12-3) detects voltage after the P contactor was commanded to open.
System Response	System shutdown, lowering enabled
Alarm Sounds	Yes
Operator Display	¤ ¤¤¤
PC Contactor	Open
Speed Limit	0 mph
How to Clear	Turn the key switch OFF and ON. If this code does not clear, follow the procedure below.

Corrective Actions and Checks

NOTE: Use step 1 if the contactor tips do open when the lift request is removed. Use steps 2 and *3* if the contact tips do not open when the request is removed.

Step	Action/ Meter Setting	(+) Lead	(–) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPT12-3	TP4	Tips open 0 Volts. Tips closed B+	Replace STM	Test P sense wire for shorts
2	Key OFF	N/A	N/A	Tips Open	Step 2	Check the Contactor for binding
3	Remove wire from JPC12-18	N/A	N/A	Tips Open	Replace STM	Find and repair short between PY and B-

Code *2,6*

Code Title	Lift Potentiometer Out of Range
Reason	The lift pot is out of the acceptable range.
System Response	Shutdown
Alarm Sounds	Yes
Operator Display	□□ □□□□□□
PC Contactor	Closed
Speed Limit	0 mph
How to Clear	Turn the key switch OFF and ON.

Corrective Actions and Checks

Step	Action/ Meter Setting	(+) Lead	(–) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPC13-8	JPC13-5	Approx. 5 volts	Step 2	Replace CM
2	DCV	JPC13-6	JPC13-5	Neutral = 0.6 to 1.7 volts Full lower = less than 2.8 volts Full lift = more than 0.2 volts	Replace CM	Adjust or replace lift potentiometer

Code 4,1

Code Title	Deadman switches do not agree
Reason	Deadman switch S2 was closed while S23 was open for at least 1 second, or vice versa.
System Response	No travel, lift is available to access deadman switches.
Alarm Sounds	Yes
Operator Display	□□□□ □
PC Contactor	Closed
Speed Limit	0 mph
How to Clear	Step on and off deadman pedal.

Corrective Actions and Checks

NOTE: Disconnect S2 and step on the deadman pedal. If the code still appears troubleshoot the S2 circuit starting with step 1. If the truck does not recognize the deadman pedal being depressed troubleshoot S23 starting with step 6.

Step	Action/ Meter Setting	(+) Lead	(–) Lead	Expected Results	Step Passed	Step Failed
1	JPC7 Disconnected / DCV	PC7-2	PC7-3	10.5 to 13 volts	Step 2	Replace CM
2	JPC7 Disconnected / DCV	JPC7-I	JPC7-3	Approx 5 volts	Step 3	Replace CM
3	DCV	S2-1	S2-3	10.5 to 13 volts	Step 4	Repair or Replace wires to CM
4	DCV	S2-2	B-	Switch closed = 0 volts Switch open = approx 5 volts	Step 5	Replace S2
5	DCV	JPC7-1	B-	Switch closed = 0 volts Switch open = approx 5 volts	Replace CM	Repair or replace wires to CM
6	JPC7 Disconnected / DCV	PC7-5	PC7-4	10.5 to 13 volts	Step 7	Replace CM

Code 5,5

Code Title	**Carriage Manager Reprogramming Failed or CM COP Not Turned ON**
Reason	Automatic re-program failed or COP (Computer Operating Properly) not turned ON.
System Response	Total shutdown
Alarm Sounds	Yes
Operator Display	11131313 13131313
PC Contactor	Open
Speed Limit	0 mph
How to Clear	Turn the key switch OFF and ON.

Corrective Actions and Checks

Step	Action/ Meter Setting	(+) Lead	(–) Lead	Expected Results	Step Passed	Step Failed
1	Replace CM	N/A	N/A	N/A	N/A	N/A

NOTE: If this code is intermittent check truck for shorts to frame and verify static straps are clean and contacting the floor.

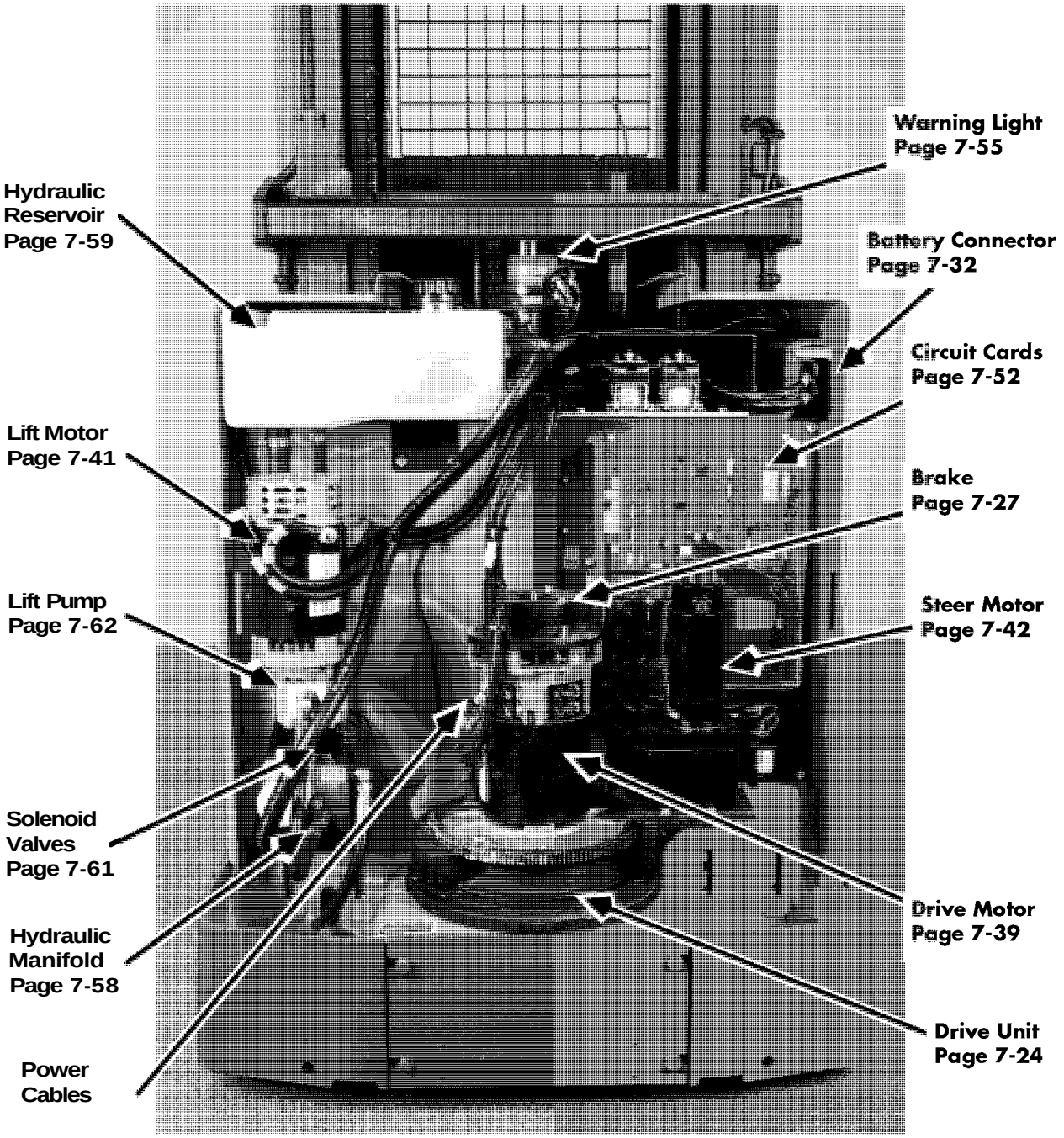

Figure 7-2. Inside Tractor

Operator Display

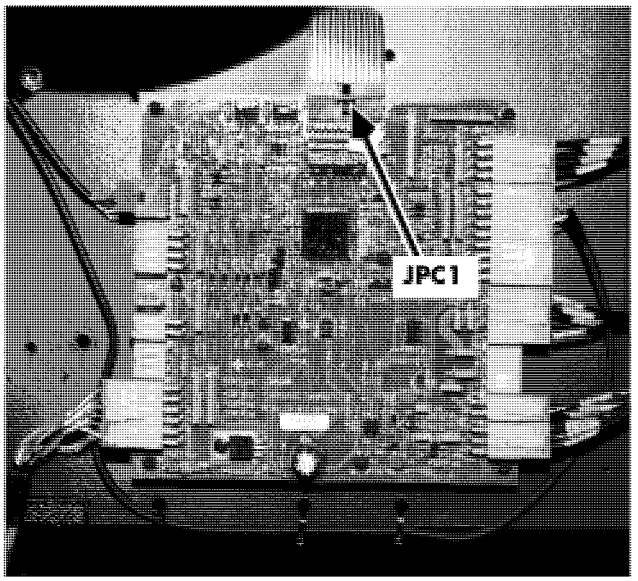

Figure 7-15. Replacing Operator Display

Replace

1. Turn key switch OFF and disconnect battery.
2. Remove operator console cover.
3. Disconnect the JPC1 from carriage manager. See Figure 7-15.
4. Peel failed operator display from console bezel.
5. Place new operator display in cut-out on console bezel.
6. Connect JPC1 to carriage manager. See Figure 7-15.
7. Install operator console cover.

longer than width of old tire to allow complete removal of old tire. The outside diameter of ram must be small enough to fit loosely in the insert of tire but must be large enough to rest squarely on flat surface on outer edge of hub.

3. If outside edge of hub is not flush with edge of metal insert in old tire, measure how far hub is recessed inside tire. The new tire must be placed in the same position the old tire was installed on hub. You can use a spacer (slightly smaller in diameter than inside diameter of tire insert and same thickness as depth of recess) to obtain proper amount of recession.
4. Position hub assembly with old tire on top of circular ram so outside of wheel is positioned upward. The outside edge of hub has a chamfer to help guide new tire onto wheel. The chamfered edge must always be leading edge when a tire is pressed onto hub.
5. Center hub assembly on top of ram and make sure that they mate squarely.
6. Position new tire with its chamfered insert facing hub. Align new tire and hub so that they are concentric.
7. Begin pressing new tire onto hub and old tire off wheel. Run press slowly for the first few inches of travel, because this is the critical stage of the operation. If tire begins to cock to one side, stop press and realign tire. A sharp jar with soft-headed mallet will usually realign tire on hub.

NOTE: If new tire does not press on with a minimum of 5 tons (68,947kPa) pressure, replace hub.

8. Release press. Remove wheel, tire assembly, and old tire from press table. Inspect wheel and tire assembly.
9. Install drive wheel. See "Drive Wheel" on page 7-25.

Set up and rigidly adhere to a strict inspection schedule to obtain the maximum efficiency from the electrical equipment.

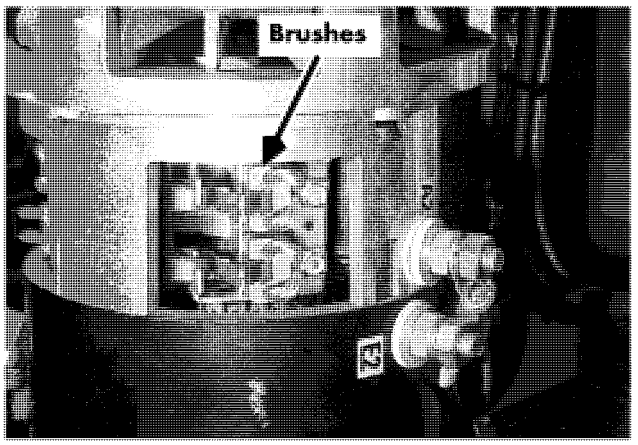

Figure 7-45. Drive Motor Brushes, location

Each partial inspection of the motor should include the following:

1. Inspect the brushes for wear and for proper contact with the commutator. Record the level of wear on the brushes. This history will give you an indication of whether a brush should be changed or if it can wait until the next inspection. Refer to page 7-37 for acceptable brush length and general motor information.

NOTE: Overloading a unit is ultimately reflected in the motor and brush wear; therefore, you must take this into account when considering brush replacement.

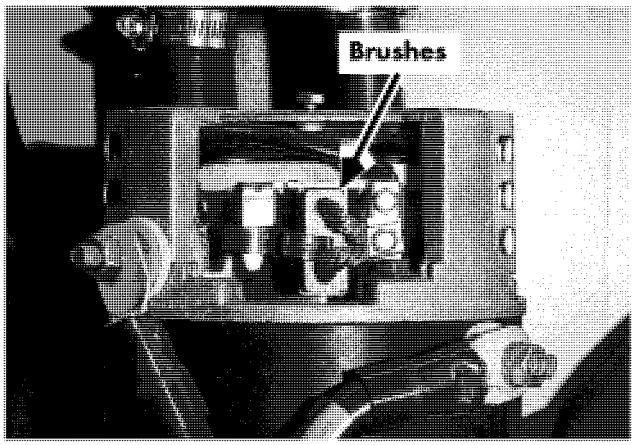

Figure 7-46. lift Motor Brushes, location

2. Check brush spring tension. See "Motor Brush Spring Tension" on page 7-37.
3. Clean brushes and holders. Wipe the commutator with a dry, lint-free cloth. DO NOT USE lubricants of any kind on or around the commutator.
4. Check brush holders for solid connection to the mounting support. Tighten the mounting screws as necessary.
5. Check the cap screws holding the brush cross connectors to the brush holder body.

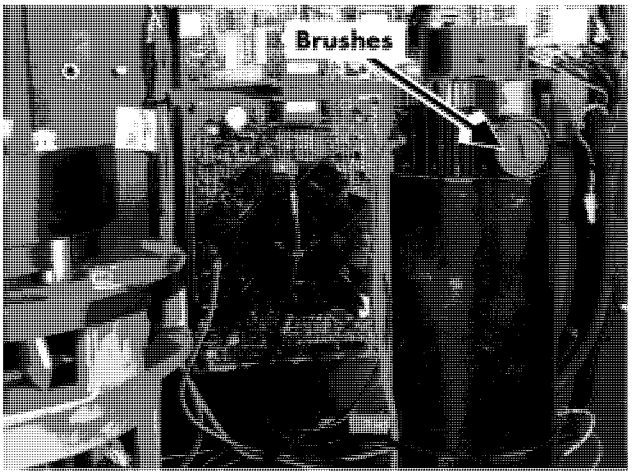

Figure 7-47. Steer Motor Brushes, location

6. Make sure the motor terminals are secured tightly to the motor frame. Be careful not to strip the threads or crush the insulating parts. See "Terminal Nuts" on page 7-38.
7. Check all the cap screws around the frame for tightness.
8. Keep the outside frame of the motor clean and free from dirt. Maintain a free air passage around the motor to permit heat radiation.

Replacement

If one brush needs replacement, always replace the entire set of brushes.

Use only genuine Toyota brushes. Using another type of brush could damage the commutator or cause excessive brush wear and will void your warranty.

Contactors

This lift truck has two contactors, the PC and pump (P) contactors. The following procedures apply to either one.

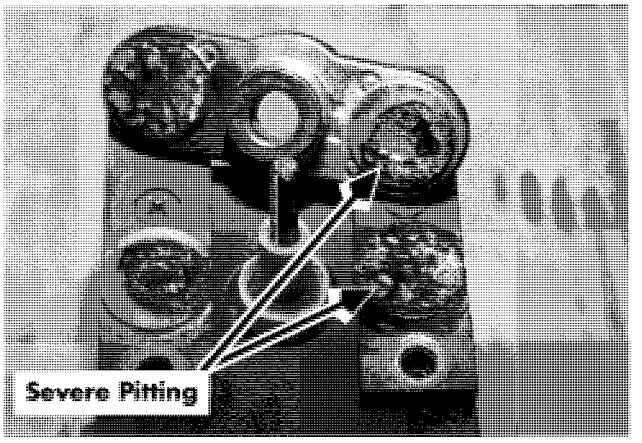

Figure 7-68. Severely Pitted Contactor Tips

Tip Inspection

When you inspect contactor tips, follow these guidelines:

- Disconnect the battery before inspecting or servicing contactor tips.
- Darkened points do *not* indicate burning.
- Burning indicates a loss of contact point material.

  Replace the contact tips if there is *not* enough contact point material to last until the next regular inspection or severe pitting is evident. See Figure 7-68.
- The silver alloy part of the point is usable contact material; the copper backing is *not*.
- Do *not* file contact tips to remove discoloration or minor irregularities. This practice produces a surface more susceptible to sticking.
- If a cone and crater appear, remove the cone with a file; Do *not* use sandpaper or emery cloth.

Remove Assembly

⚠CAUTION

When repairing contactors, use only Toyota authorized contactor kits.

1. Turn key switch OFF and disconnect battery.
2. Remove tractor covers. See "Tractor Covers" on page 7-11.
3. Remove control panel cover. See Figure 7-69.

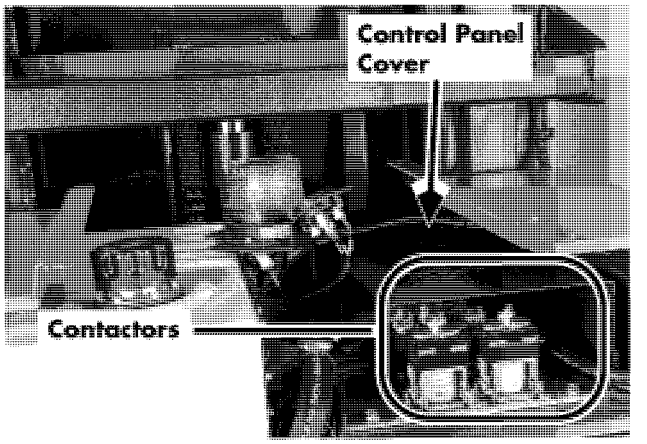

Figure 7-69. Top of Tractor

4. Identify contactor to be removed. See Figure 7-71.

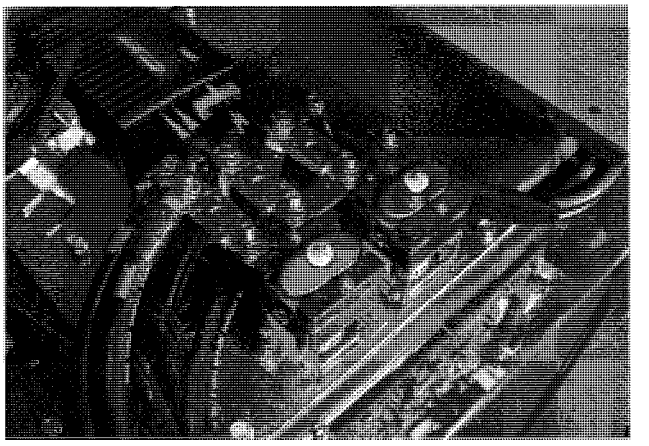

Figure 7-70. Control Panel, Top View

5. Disconnect appropriate cables and fuses by removing hex nuts. Note their location

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Installation

1. Install cylinder in the truck.
2. Install the bolt that attaches the cylinder housing to the main frame of the truck.
3. Install the snap ring on the bottom of the cylinder housing. See Figure 7-97.
4. Unblock the mast and lower the platform far enough to collapse the other outer cylinder but still have access to the fitting at the bottom of the cylinder.
5. Block the platform in place. Connect the tubing to the bottom of the cylinder.
6. Unblock and lower the platform to the floor. Install the bolt in the top of the lift cylinder that connects it to the bracket on the **mast.**
7. Bleed hydraulic system. See "Bleeding the Hydraulic System" on page 7-64.
8. Lift and lower carriage completely to check lift function.

Cushion Service

1. Remove cylinder from truck. See "Side Cylinder" on page 7-65.
2. Remove snap ring and wiper. See Figure 7-99.

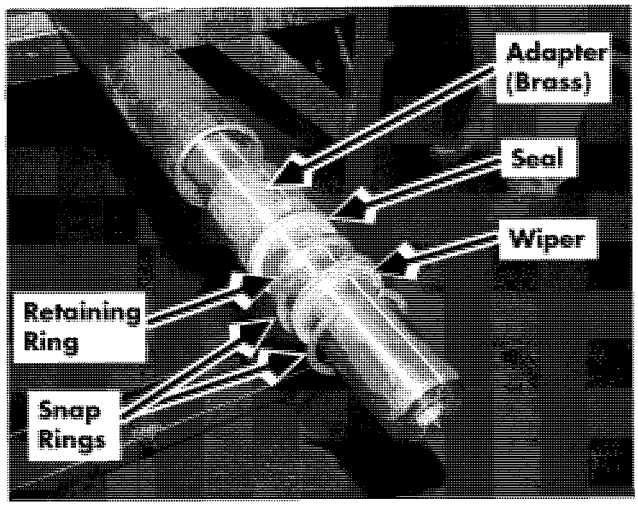

Figure 7-99. Piston Removal

3. Remove snap ring in cylinder housing.
4. Pull piston until piston stop pushes retaining ring, packing and adapter out of cylinder. See Figure 7-99.
5. Pull piston out of housing. Place piston on cushioned stand. Do not damage piston surface.
6. Push cushion into piston at base of piston.

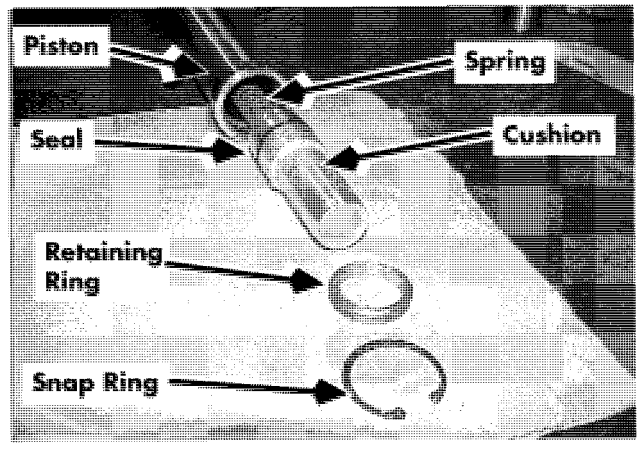

Figure 7-100. Cushion, Removed

⚠CAUTION

The cushion is under extreme pressure. Keep pressure on the cushion when removing the items in the next step. Failure to do so could cause injury from projectile parts.

7. Remove snap ring and retaining ring. See Figure 7-100.
8. Release pressure on cushion and pull cushion out of piston. See Figure 7-100.
9. Remove spring. See Figure 7-100.

9. Tie electric cables to platform. See Figure 7-116.

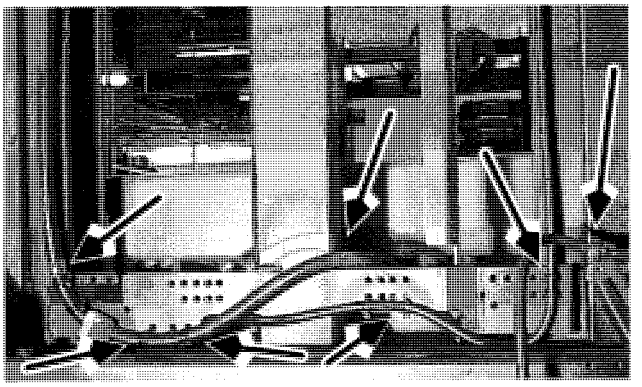

Figure 7-116. Tie Points for Cables on Platform, Backside

10. Install carriage stops at top of inner mast. See Figure 7-117.

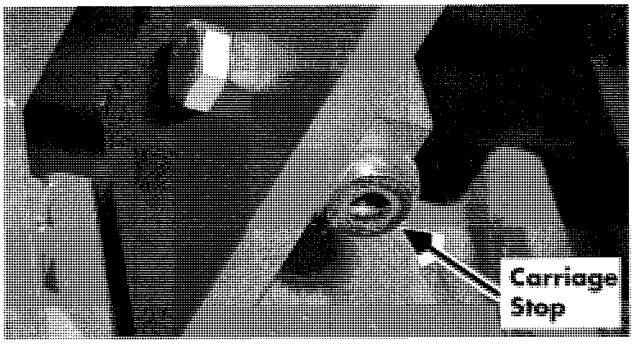

Figure 7-117. Inner mast, Top Corner

11. Lower carriage and install cable on bottom pulley of carriage. Install cable retainer spring. See Figure 7-118.

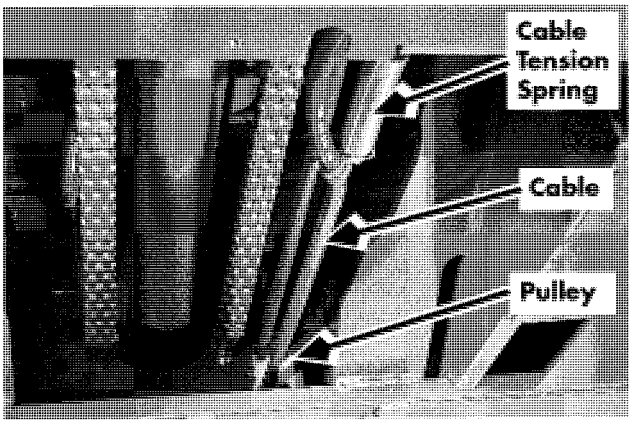

Figure 7-118. Electrical Over-the-Mast Cable, Front Side of Platform

NOTE: There are 6 in.(152 mm) from the top of the spring on the carriage to the center bolt in the cable clamp.

12. Install carriage plate.
13. Install mast guard.
14. Lift and lower platform fully, and check functions of lift system. Look for:
    - Oil leaks
    - Cables on pulleys
    - Switch actuation
    - Unusual bearing noise

Center Cylinder Ride Spring Chain Anchors

Inspection of the chain anchors and pivot rocker should be done any time that the chains are lubricated and adjusted.

Inspection

1. Remove the operator compartment console cover and tractor cover.
2. Lift the operator platform just high enough to have the chain anchor/pivot rocker visible through the opening under the operator control panel.
3. Place blocking under the operator's platform. Lower the platform onto the support.
4. Disconnect the battery connector and open the emergency lower valve.

   The center cylinder will move down and the chains will go slack. If the center cylinder does not go down far enough to slacken the chains, push down on the top of the cylinder. This will allow the chain anchor to be visible for inspection. See Figure 7-119.

The shims used under each roller bearing come in the following sizes: thin, medium, and thick. If the bearings are too loose, you should add shims to the bearing. If the roller bearings are shimmed too tight, causing wear along the I-beam or mast shaving, reduce the shim thickness. Although different combinations of shims may be used to obtain the proper adjustment, you should try to maintain equal shim thickness on each side of the main frame and masts.

Upper Mast Bearing Replacement

⚠ WARNING

Use extreme care when blocking the mast for any reason. Never remove the block when it is supporting the mast.

1. Slightly elevate the carriage to gain access to the bearings.
2. Block the carriage before you attempt to remove the roller bearing.

   You may also use a lift hoist to pull the carriage upward to gain access to the roller bearing. Put a strap suitable to handle the weight of the carriage around the uppermost cross tie. Once the carriage is raised in place, block it into position.
3. Turn the key switch OFF and disconnect the battery connector.

⚠CAUTION

Do not damage the mast when prying with the screwdriver.

NOTE: For the upper mast bearings, wedge a screw driver between the roller bearing and the mast to prevent the bearing from falling.

NOTE: When removing the roller bearing, use caution not to let the bearing fall down into the mast assembly.

4. Remove the bolt securing the roller bearing to the respective mast or mast.

NOTE: If the bearings are worn or damaged, replace them.

5. Install the same number of shims under the bearing that were removed.
6. Make sure the roller bearing mounting bolts are clean before you install them.
7. Apply thread-locking compound (P/N 00590-04964-71) on the threads. Torque the bolts per Table 7-2.
8. Reconnect the battery connector and turn the key switch ON.
9. Lift the carriage and mast and unblock the mast.
10. Test the operation of the masts.
11. Return the truck to service.

Table 7-2: Mast Bearing Stud Retaining Bolt Torque Values

Location	*Torque
Main Frame	300 ft. lb. (406.7 N•m)
Outer Mast Upper	250 ft. lb. (339 N•m)
*After torquing, back bolt off 1/4 to 1/2 turn.	

Load Wheels

⚠ WARNING

Use extreme care whenever the truck is jacked up. Keep hands and feet clear of from the vehicle while jacking the truck. After the truck is jacked, place solid blocks beneath it to support it. DO NOT rely on the jack alone to support the truck. See "Jacking Safety" on page 2-11.

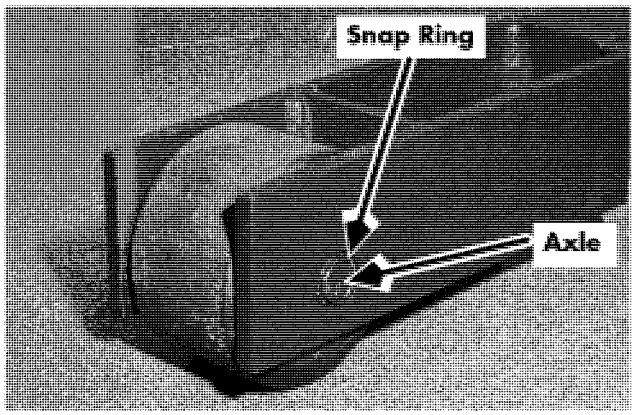

Figure 7-146. load Wheel

1. Raise operator platform approximately 1 ft. from the floor. Place a 4 x 4 inch (10 x 10 cm) block across top of baselegs underneath platform.
2. Turn key switch OFF and disconnect battery.
3. Jack up baseleg high enough to clear load wheel from under baseleg. Block under baseleg.
4. Remove snap ring from axle. See Figure 7-146.
5. Drive out axle. The load wheel will fall out of baseleg. See Figure 7-146.
6. Replace load wheel assembly.
7. Drive axle back through wheel and baseleg.
8. Install snap ring.
9. Remove blocks.

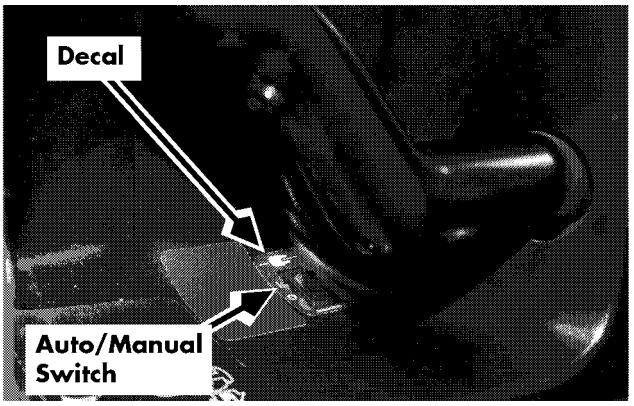

Figure 8-16. Auto/Manual Switch, Installed

Code 9,2

Step	Action/ Meter Setting	(+) Lead	(–) Lead	Expected Results	Step Passed	Step Failed
6	Sensor removed / mVAC (LR)	JPW1-I	B-	Centered: 32 mV 1.5 in Left; 15mV 1.5 in Right; 76 mV	step 7	Replace Antenna Card
7	Bumper removed / DCV (TR)	JP1-A16 (Filter Card)	B-	Centered: 1.1V 1.5 in Left; 0.6V 1.5 in Right; 2.8V	step 8	Replace Filter Card
8	Sensor removed/ mVAC (LN)	JPW1-2	B-	Centered: 70mV 1.5 in Left; 1OOmV 1.5 in Right; 100mV	step 9	Replace Antenna Card
9	Sensor removed / DCV (LN)	JP1-A6 (filter card)	B-	Centered: 2.5V 1.5 in Left; 3.7V 1.5 in Right; 3.7V	step 10	Replace filter card
10	JPW2 and JP1T disconnected / ohms	JPW2-1 to 15	JP1T-1 to 15	0 Ohms	step 11	Replace cable
11	JPT2 disconnected / DCV	PW2-15	PW2-14	Approx. 11.5V	step 13	step 12
12	Filter card removed / DCV	JP1-B1 (filter card)	JP1-A13 (filter card)	Approx. 11.5V	Replace filter card	Replace Steer Controller card
13	Bumperremoved / mVAC (TL)	JPW2-3	B-	Centered: 32mV 1.5 in Left; 15mV 1.5 in Right; 76mV	step 14	Replace antenna card
14	Bumper removed / DCV (TL)	J P1-A15	B-	Centered: 1.1V 1.5 in Left; 0.6V 1.5 in Right; 2.8V	step 15	Replace filter card
15	Bumper removed / mVAC (TR)	JPW2-I	B-	Centered: 32mV 1.5 in Left; 15mV 1.5 in Right; 76mV	step 16	Replace antenna card
16	Bumper removed / DCV (TR)	J P1-A16 (Filter card)	B-	Centered: 1.1V 1.5 in Left; 0.6V 1.5 in Right; 2.8V	step 17	Replace filter card
17	Bumper removed / mVAC (TN)	JPW2-2	B-	Centered: 70mV 1.5 in Left; 100mV 1.5 in Right; 1OOmV	step 18	Replace antenna card
18	Bumper removed / DCV (TN)	JP1-A5 (Filter card)	B-	Centered: 2.5V 1.5 in Left; 3.7V 1.5 in Right; 3.7V	Replace Steer Controller Card	Replace filter card

Code 9,F

Code Title	No filter card installed
Reason	The guidance manager detects the filter card is not connected at JS1.
System Response	
Alarm Sounds	Yes
Operator Display	oooooo oo
Guidance Manager Display	9F
PC Contactor	Open
Speed Limit	0 mph
How to Clear	Turn the key switch OFF then ON. If the code does not clear, follow the procedure below.

Corrective Actions and Checks

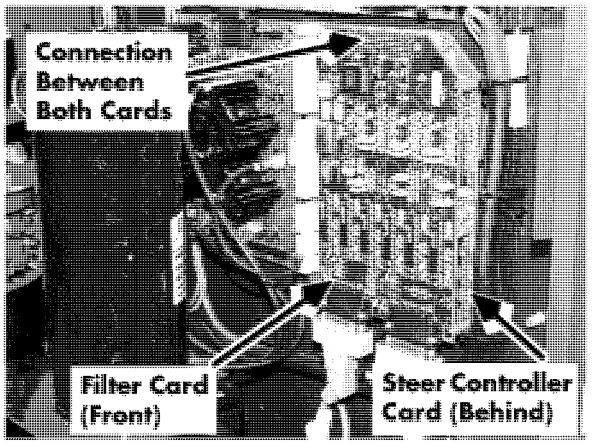

Figure 8-17. Steer Controller Card and Filter Card, Installed

Step	Action/ Meter Setting	(+) Lead	(–) Lead	Expected Results	Step Passed	Step Failed
	DCV	JS1-A6	B-	Filter card plugged in = 0 volts Filter card unplugged = 4.5 to 5.5 volts	Replace Steer controller	If 5 volts is read all the time, replace the filter card. If 5 volts is never read, replace steer controller card

Troubleshooting in FlashWare

1. Use the 9-pin serial cable to connect the laptop to the truck.
2. While in *auto* mode, drive the truck on the wire at full speed to the end of the aisle (at least 50 feet [15 meters]) and back forks-first to verify that the truck is guiding on the wire.
3. Without driving or moving the steering wheel, toggle the auto/manual switch from *auto* mode to *manual* mode and back to *auto* mode.
4. Drive the truck tractor-first at full speed on the wire to the end of the aisle (at least 50 feet [15 meters]) and immediately drive back on the wire, forks-first, at least 50 feet (15 meters).
5. Switch to manual mode and drive off and away from the guide wire.
6. Using the FlashWare software program, go to the Wire Guidance Diagnostics menu.
   a. At the main menu prompt, type **d** for diagnostics.
   b. At the diagnostics menu prompt, type **w** for wire guidance.

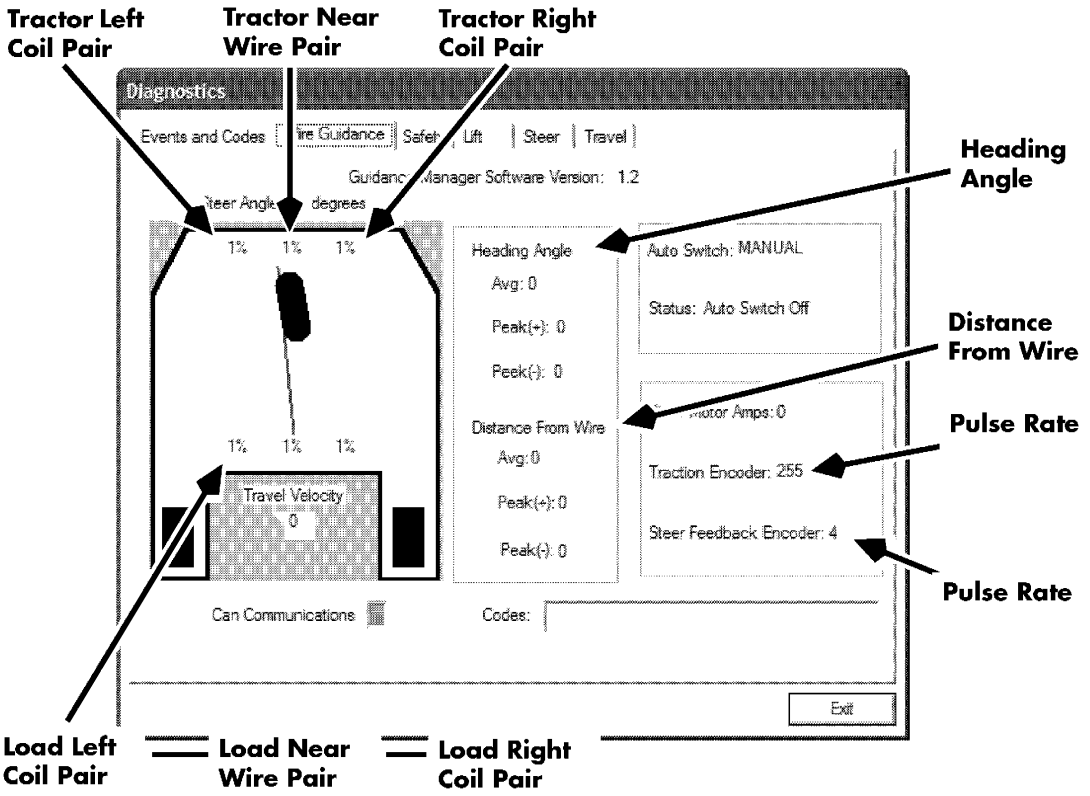

Figure 8-19. Wire Guidance Diagnostics Screen

7. Check the values for the parameters in the following table. See Figure 8-19. If the truck shows higher values than listed below, perform the procedure for General Troubleshooting beginning on page 8-35.

Parameter	Must Be Less Than:
Average Heading Angle	0.75
Maximum Peak Heading Angle	1

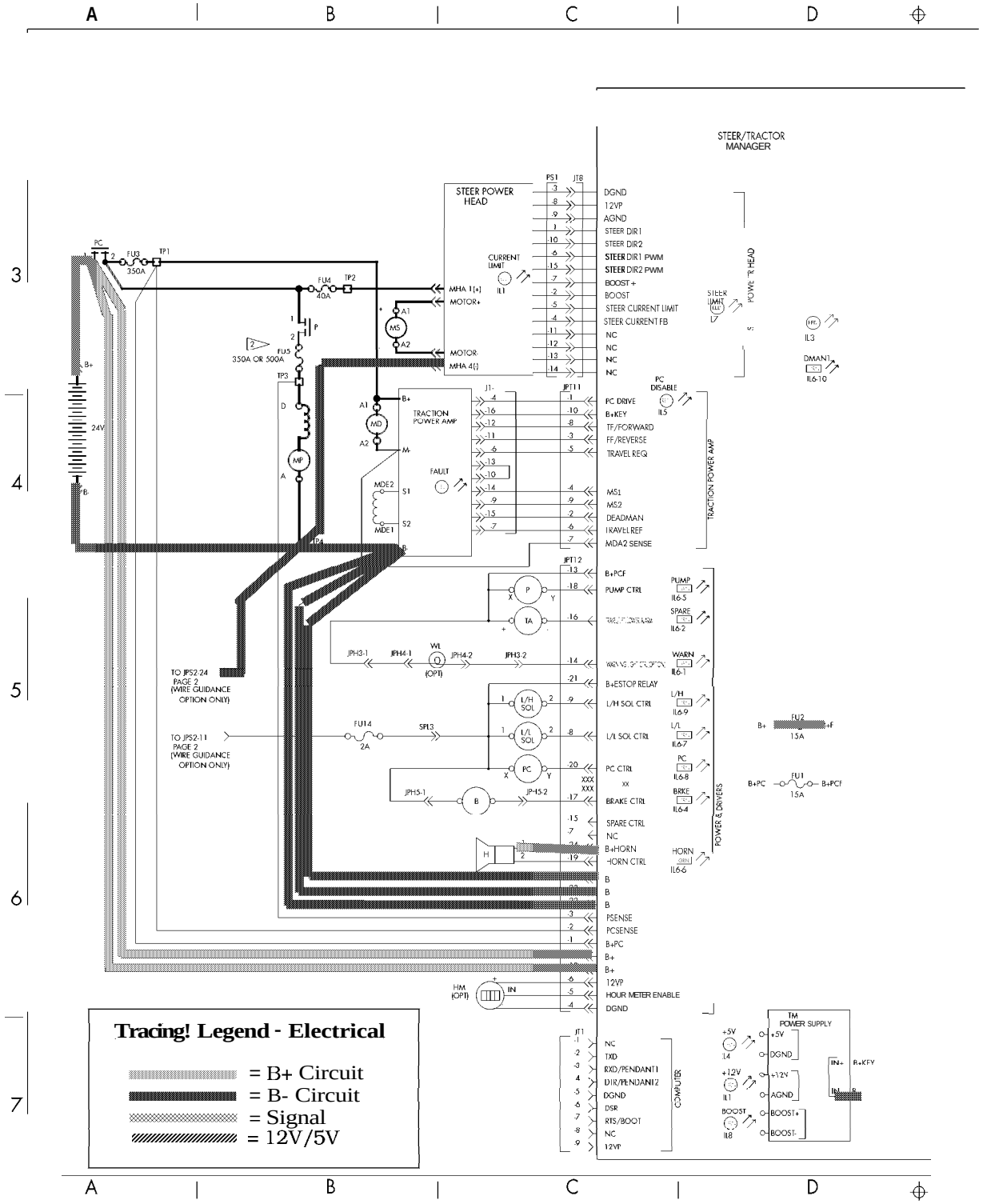

Figure 9-2. Battery Plugged In (Sheet 1 of 4)

Closing Deadman Switches

Stepping on the deadman pedal closes deadman switches S2 (Deadman 1) and S23 (Deadman 2). Both switches must be closed to travel, lift/lower and/or steer. If either switch opens while traveling, the travel command to the traction power amplifier stops and the brake is applied.

1. With S2 closed, a circuit is completed between JPC7-3 and JPC7-1 on the carriage manager.
2. With S23 closed, a circuit is completed between JPC7-6 and JPC7-4 on the carriage manager.
3. With the S2 (Deadman 1) circuit complete, the micro processor on the CM detects that the switch is closed. The carriage manager communicates to the steer/tractor manager via the transmit line that switch S2 is closed.
4. The Deadman 2 input from S23 is wired directly through the mast cable from the carriage manager (JPC8-5) to the steer/tractor manager (JPT9-5). The CM does not look at the input or use it for anything.
5. The Deadman 1 message and Deadman 2 input are received by the steer/tractor manager and monitored continually to ensure they both agree. If only one of the switches closes while the pedal is depressed the operator display indicates a fault. LEDs on the steer/tractor manager for Deadman 1 (IL6-10) and Deadman 2 (IL2) are lit when the switches are closed.
6. After the steer/tractor manager determines both Deadman switches agree, it turns on the PC contactor coil driver which is indicated by an LED (IL6-8). With this coil driver on, a current path is completed between JPT12-21 and JPT12-20 which energizes the PC contactor coil.
7. The PC contactor tips close and battery voltage is supplied to the following:
   - TP1, TP2
   - B+ side of the open pump (P) contactor tips, P-1
   - MHA-1 on the steer power head
   - Drive motor (MD) armature terminal A1
   - B+ terminal of traction power amplifier
   - M- terminal of traction power amplifier
   - Drive motor (MD) armature terminal A2
   - MDA2 sense at JPT11-7
   - JPT12-1 as B+PC
   - FU1 as B+PC and B+PCF
   - JPT12-2 as PCSENSE
   - JPT12-13 to pump contactor coil (X) terminal as B+PCF
   - JPT12-13 to warning light as B+PCF (optional)
8. The steer/tractor manager also turns on the brake coil driver which is indicated by an LED (IL6-4).With this coil driver on, a current path is completed between JPT12-21 and JPT12-17 and the brake releases. If the Deadman switches are opened during travel the brake will be applied immediately.
9. After the truck has completed self-diagnostics and the deadman pedal is depressed, the STM looks at the input from the Home Reference Proximity Sensor. If the prox is over metal, the STM will turn the drive unit to the left. As soon as the prox switch transitions from metal to no metal the STM removes the steer command. If it is not over metal, the drive unit turns to the right. Once the home prox transitions from off to on, the STM turns the drive unit back to the left until the switch transitions to no metal and removes the steer command. This position is considered center and the position register for the steer feedback encoder is set to a zero reference point. During the auto steer center function, the STM monitors the steer feedback encoder and the steer motor current to verify the drive unit is actually powered and moving in the proper direction. If the STM does not see current or encoder pulses, an error code displays. If the STM does not see a home reference proximity sensor transition, it

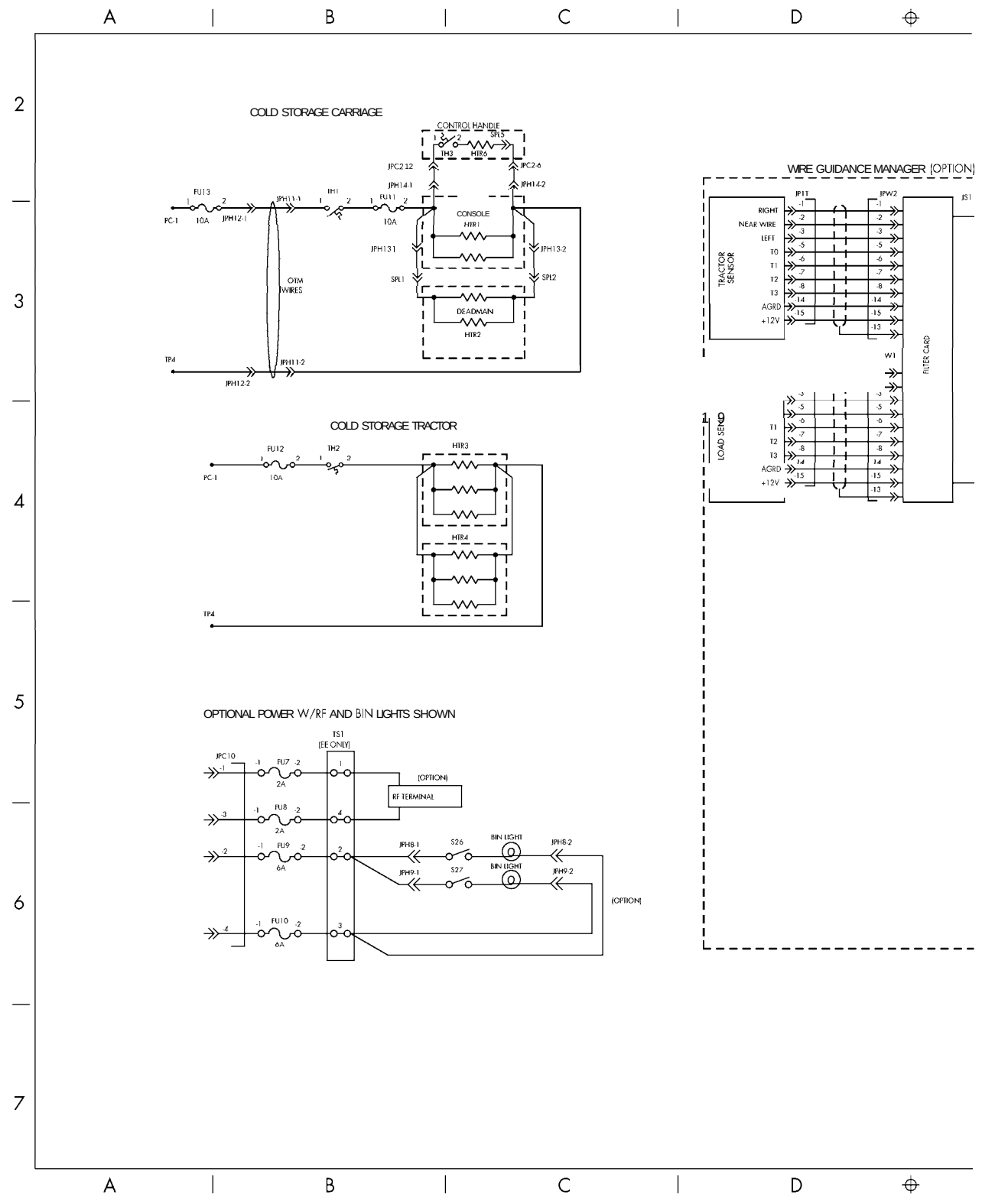

Figure 9-5 (Cont.). Moving Speed/Directional Control (Sheet 3 of 4)

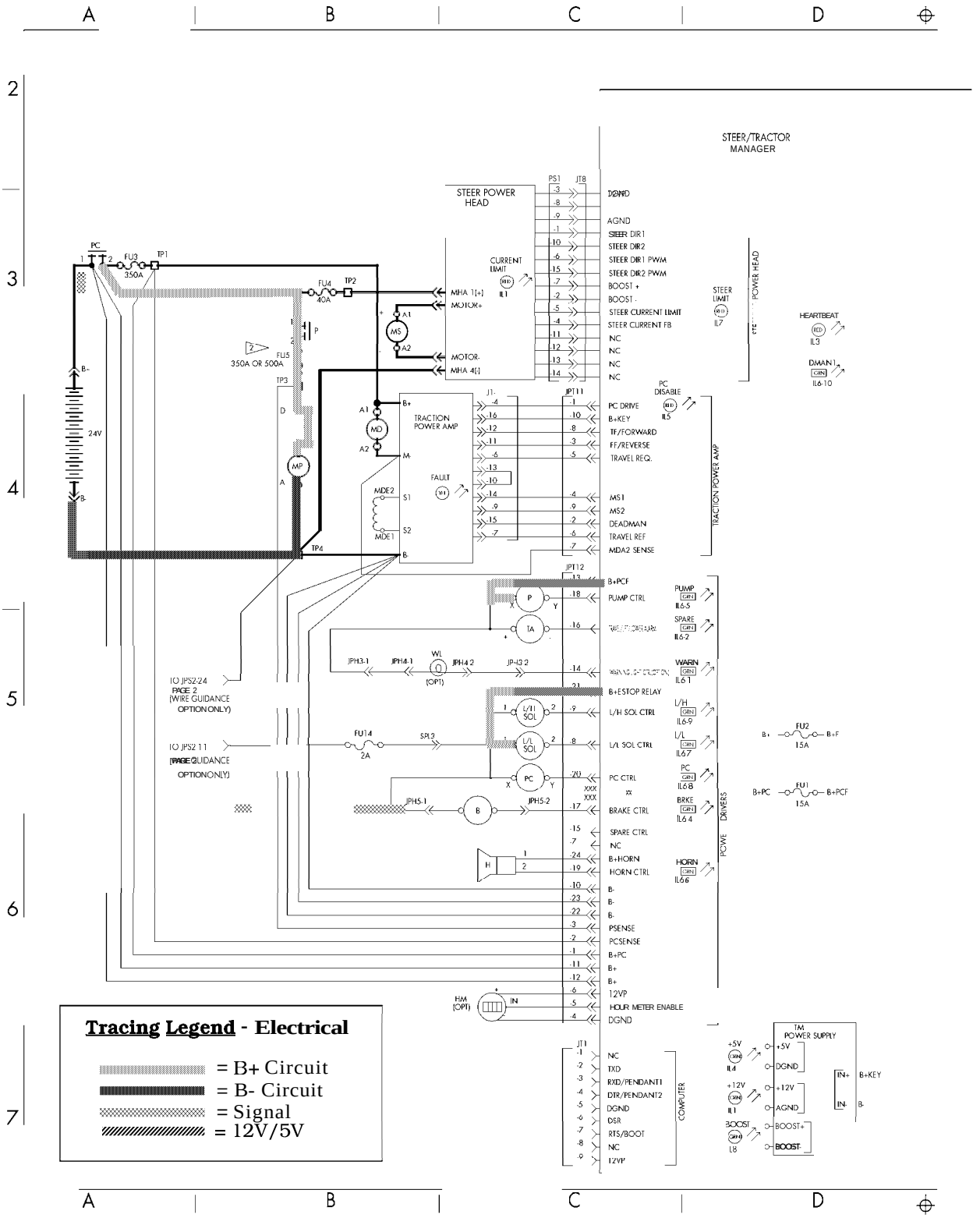

Figure 9-9. Lift (Sheet 1 of 4)

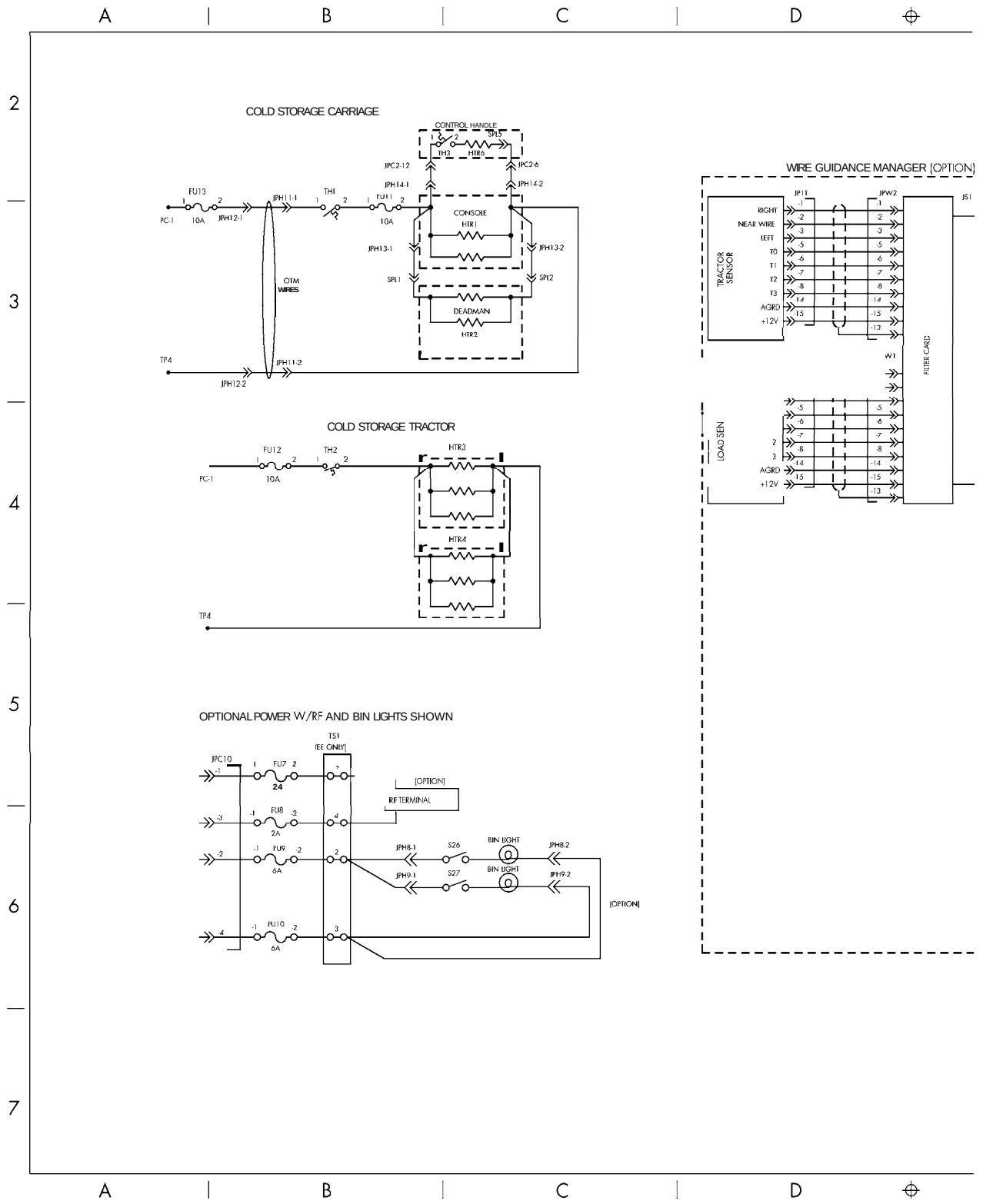

Figure 9-13 (Cont.). Lower (Sheet 3 of 4)

Pinout Matrix

Item #	Connection	Function Description	Theory of Operations	Normal Level	Signal Source	Signal User
	JPT12-22	B–	One of the three B– lines that provide a return path for the control circuits that are powered by B+. Measure battery voltage from a B+ terminal to JPS14-4 to verify connections.	<0.5Vdc wrt TP4 (B–)	B– power cable at the traction amp	STM
	JPT12-3	P SENSE	The STM monitors the voltage in the Lift Motor circuit. The TM/VFC uses this voltage to determine the state of the P Contactor tips to verify that they are in the correct state and to initiate P contactor codes. It is also used to detect when the lift motor stops rotating. That information is used for proper sequencing of the L/L and L/H Sol Valves.	B+ when the P contactor is closed. 0 volts when the P contactor is open.	P Contactor	STM
	JPT12-2	PC SENSE	PC Sense monitors the voltage on the output side of the PC contactor. It is used by the STM to verify the correct state of the PC Contactor and initiate PC codes.	B+ w/PC contactor closed 0V w/PC contactor open	PC Contactor	STM
	JPT12-1	B+PC	B+ to the Tractor Manager when the PC tips are closed. This voltage supplies FU1 and then used to supply anything labeled as B+PCF.	B+ w/PC contactor closed 0V w/PC contactor open	PC Contactor	STM
	JPT12-11	B+	B+ from PC1 present when the battery is plugged in. It is fused by FU2 and then used to supply anything labeled B+F.	B+ with battery connected 0V with battery disconnected	Connecti on 1 on PC Contactor	STM
	JPT12-12	B+	B+ from PC1 present when the battery is plugged in. It is fused by FU2 and then used to supply anything labelled B+F.	B+ w/battery connected 0V w/battery disconnected	Connecti on 1 on PC Contactor	STM
	JPT12-6	12VP	Supplies working voltage to the hour meter. If not present, check voltage at STM JPT9-6 and see if IL1 is lit.	+10.9Vdc with key switch closed.	STM	Hour Meter
	JPT12-5	HOUR METER ENABLE	Path for the STM to supply B- to the hour meter.	Deadman closed= 12V. Deadman Up= 24V.		
	JPT12-4	DGND	Battery negative for the control circuitry on the steer power head. It comes from the STM.	<0.5Vdc wrt TP4 (B–)	STM	Steer Power Head
	JT1-1	NC	Not connected to any circuitry on the STM.	NA	NA	NA
	JT1-2	TXD	Connection for computer interface no usable measurements available.	No useful voltages are measurable		
	JT1-3	RXD/PENDANT 1	Connection for computer interface no usable measurements available.	No useful voltages are measurable		

Pinout Matrix

Item #	Connection	Function Description	Theory of Operations	Normal Level	Signal Source	Signal User
	JPW2-1	RIGHT	This is the input from the right tractor sensor coil to the filter card. Centered over the wire you should see around 32mVAC. 1.5 in. to the right you should see around 75mVAC. 1.5 in. left you should see around 15mVAC.		Antenna Card	Filter Card
	JPW2-2	NEAR WIRE	This is the input from the tractor near wire sensor coil to the filter card. Centered over the wire you should see around 70mVAC. 1.5V to either side you should see around 100mVAC.		Antenna Card	Filter Card
	JPW2-3	LEFT	This is the input from the left tractor sensor coil to the filter card. Centered over the wire you should see around 32mVAC. 1.5 in. to the right you should see around 15mVAC. 1.5 in. left you should see around 75mVAC.		Antenna Card	Filter Card
	JPW2-5	T0	Communication lines used by the steer controller card to tell the antenna card which frequency it should be looking for.	No useful voltages are measurable	Steer Controller Card	Antenna Card
	JPW2-6	T1	Communication lines used by the steer controller card to tell the antenna card which frequency it should be looking for.	No useful voltages are measurable	Steer Controller Card	Antenna Card
	JPW2-7	T2	Communication lines used by the steer controller card to tell the antenna card which frequency it should be looking for.	No useful voltages are measurable	Steer Controller Card	Antenna Card
	JPW2-8	T3	Communication lines used by the steer controller card to tell the antenna card which frequency it should be looking for.	No useful voltages are measurable	Steer Controller Card	Antenna Card
	JPW2-14	AGRD	B– to the antenna card.	<0.5Vdc wrt TP4 (B–)	Steer Controller Card	Antenna Card
	JPW2-15	12 V	Positive supply from the steer controller card power supply for the antenna card.	+10.8 - 13Vdc with key switch closed	Steer Controller Card	Antenna Card
	JPW2-13	SHIELD	Shield that helps reduces noise interference in the AC voltage from the antenna card. It must be connected to B– on the at the filter card connection only.	<0.5Vdc wrt TP4 (B–)	Steer Controller Card	Antenna Card
	JPW1-1	RIGHT	This is the input from the left tractor sensor coil to the filter card. Centered over the wire you should see around 32mVAC. 1.5 in. to the right you should see around 15mVAC. 1.5 in. left you should see around 75mVAC.		Antenna Card	Filter Card

Decimal Equivalent Chart

4ths	8ths	16ths	32nds	64ths	To 3 Places	To 2 Places	MM Equivalent
				1/64	.016	.02	.397
			1/32		.031	.03	.794
				3/64	.047	.05	1.191
		1/16			.062	.06	1.587
				5/64	.078	.08	1.984
			3/32		.094	.09	2.381
				7/64	.109	.11	2.778
	1/8				.125	.12	3.175
				9/64	.141	.14	3.572
			5/32		.156	.16	3.969
				11/64	.172	.17	4.366
		3/16			.188	.19	4.762
				13/64	.203	.20	5.159
			7/32		.219	.22	5.556
				15/64	.234	.23	5.593
1/4					.250	.25	6.350
				17/64	.266	.27	6.747
			9/32		.281	.28	7.144
				19/64	.297	.30	7.540
		5/16			.312	.31	7.937
				21/64	.328	.33	8.334
			11/32		.344	.34	8.731
				23/64	.359	.36	9.128
	3/8				.375	.38	9.525
				25/64	.391	.39	9.922
			13/32		.406	.41	10.319
				27/64	.422	.42	10.716
		7/16			.438	.44	11.112
				29/64	.453	.45	11.509
			15/32		.469	.47	11.906
				31/64	.484	.48	12.303
1/2					.500	.50	12.700

Figure A-5. Decimal Equivalent Chart

NOTES:
1. SCHEMATIC SHOWS TRUCK SWITCHED OFF, DEADMAN SWITCH OFF AND CARRIAGE FULLY LOWERED.
2. 350A FUSE FOR STANDARD TRUCK, 500A FOR HIGH PERFORMANCE.
3. REFERENCE POWER DISTRIBUTION DIAGRAM D20008910.

IDENT.	SHEET	ZONE	DESCRIPTION
B	1	C5	ELECTRICALLY RELEASED BRAKE
B+	1	A3	BATTERY CONNECTOR
B-	1	A4	BATTERY CONNECTOR
FU1	1	D5	CONTROL FUSE FOR B+PC, 15 AMPS
FU2	1	D5	CONTROL FUSE FOR B+, 15 AMPS
FU3	1	A3	POWER FUSE FOR TRACTION MOTOR, 350 AMPS
FU4	1	B3	POWER FUSE FOR STEER MOTOR, 40 AMPS
FU5	1	B3	POWER FUSE FOR LIFT PUMP MOTOR, 350 OR 500 AMPS
FU7	2	B5	CONTROL FUSE FOR RF TERMINAL B+, 2 AMPS
FU8	2	B6	CONTROL FUSE FOR RF TERMINAL B-, 2 AMPS
FU9	2	B6	CONTROL FUSE FOR LIGHTS & FAN B+, 6 AMPS
FU10	2	B6	CONTROL FUSE FOR LIGHTS & FAN B-, 6 AMPS
FU11	2	B2	CONTROL FUSE FOR CARRIAGE HEATERS, 10 AMPS (COLD STORAGE OPTION)
FU12	2	B4	CONTROL FUSE FOR TRACTOR HEATERS,10 AMPS (COLD STORAGE OPTION)
FU13	2	A2	CONTROL FUSE FOR CARRIAGE HEATERS, 10 AMPS (COLD STORAGE OPTION)
FU14	1	B5	CONTROL FUSE FOR GUIDANCE MANAGER B+ESTOP, 2A (WIRE GUIDANCE OPTION).
H	1	C6	ELECTRONIC HORN
HM	1	C6	HOUR METER
HTR1	2	B3	HEATER FOR OPERATOR'S CONSOLE (COLD STORAGE OPTION)
HTR2	2	B3	HEATER FOR DEADMAN (COLD STORAGE OPTION)
HTR3	2	B4	HEATER FOR TRACTOR COMPARTMENT (COLD STORAGE OPTION)
HTR4	2	B4	HEATER FOR TRACTOR COMPARTMENT (COLD STORAGE OPTION)
HTR6	2	B2	HEATER FOR CONTROL HANDLE (COLD STORAGE OPTION)
IL1(CM)	1	G6	CARRIAGE MANAGER HEARTBEAT LED; STEADY ON = +5V PRESENT, BLINKING SLOW = PROGRAM RUNNING, BLINKING CODE = ERROR CONDITION
IL1(SPH)	1	C3	STEER POWER HEAD STEER CURRENT LIMIT LED; ON = CURRENT LIMIT
IL1(STM)	1	D7	STEER/TRACTOR MANAGER +12 VOLT POWER SUPPLY LED; ON = +12V PRESENT
IL2(STM)	1	D4	STEER/TRACTOR MANAGER DEADMAN 2 SWITCH (S23) LED; ON = SWITCH DEPRESSED
IL2(CM)	1	G4	CARRIAGE MANAGER COMMUNICATIONS RECEIVE LED; BLINKING = RECEIVING COMMUNICATION
IL3(STM)	1	D3	STEER/TRACTOR MANAGER HEARTBEAT LED; BLINKING SLOW = PROGRAM RUNNING, BLINKING CODE = ERROR CONDITION
IL3(CM)	1	G5	CARRIAGE MANAGER COMMUNICATIONS TRANSMIT LED; BLINKING = TRANSMITTING COMMUNICATION
IL4(STM)	1	D7	STEER/TRACTOR MANAGER +5 VOLT POWER SUPPLY LED; ON = +5V PRESENT
IL5(STM)	1	D3	STEER/TRACTOR MANAGER PC DISABLED LED; ON = OEM TRACTION CONTROLLER HAS DE-ENERGIZED THE PC CONTACTOR
IL6-1	1	D5	STEER/TRACTOR MANAGER WARNING LIGHT CONTROL LED; ON = CONTROL OUTPUT ACTIVATED
IL6-2	1	D5	STEER/TRACTOR MANAGER SPARE CONTROL LED; ON = CONTROL OUTPUT ACTIVATED
IL6-4	1	D5	STEER/TRACTOR MANAGER BRAKE CONTROL LED; ON = CONTROL OUTPUT ACTIVATED
IL6-5	1	D4	STEER/TRACTOR MANAGER PUMP CONTACTOR CONTROL LED; ON = CONTROL OUTPUT ACTIVATED
IL6-6	1	D6	STEER/TRACTOR MANAGER HORN CONTROL LED; ON = CONTROL OUTPUT ACTIVATED
IL6-7	1	D5	STEER/TRACTOR MANAGER LIFT/LOWER SOLENOID CONTROL LED; ON = CONTROL OUTPUT AVTIVATED (BRIGHTNESS INDICATES % PWM)
IL6-8	1	D5	STEER/TRACTOR MANAGER POWER CUTOFF CONTACTOR CONTROL LED; ON = CONTROL OUTPUT ACTIVATED
IL6-9	1	D5	STEER/TRACTOR MANAGER LOAD HOLD SOLENOID CONTROL LED; ON = CONTROL OUTPUT ACTIVATED
IL6-10	1	D3	STEER/TRACTOR MANAGER DEADMAN 1 SWITCH (S2) LED; ON = SWITCH DEPRESSED
IL7	1	D3	STEER/TRACTOR MANAGER STEER CURRENT LIMIT LED; ON = CURRENT LIMIT
IL8	1	D7	STEER/TRACTOR MANAGER BOOST POWER SUPPLY LED; ON = BOOST VOLTAGE PRESENT
IL9	1	D5	STEER/TRACTOR MANAGER COMMUNICATIONS TRANSMIT LED; BLINKING = TRANMITTING COMMUNICATIONS
IL10	1	D5	STEER/TRACTOR MANAGER COMMUNICATIONS RECEIVE LED; BLINKING = RECEIVING COMMUNICATIONS
J1	1	C3	TRACTION POWER AMP CONNECTOR
JPC1	1	F2	CARRIAGE MANAGER CONNECTOR FOR DISPLAY CARD
JPC2	1,2	G2,B2	CARRIAGE MANAGER CONNECTOR FOR STEER INPUT ENCODER
JPC3	1	G3	CARRIAGE MANAGER CONNECTOR LOWER LIMIT & W/G AUTO MANUAL SWITCHES
JPC5	1	G5	CARRIAGE MANAGER CONNECTOR FOR LIFT/LOWER LIMIT BYPASS SWITCH
JPC6	1	G2	CARRIAGE MANAGER CONNECTOR (SPARE)
JPC7	1	G5	CARRIAGE MANAGER CONNECTOR FOR DEADMAN/LIMIT SWITCHES
JPC8	1	F4	CARRIAGE MANAGER CONNECTOR FOR MAST CABLE 1 (SIGNALS)
JPC9	1	F4	CARRIAGE MANAGER CONNECTOR FOR MAST CABLE 1 (POWER)
JPC10	1	F3	CARRIAGE MANAGER CONNECTOR FOR SPARE POWER
JPC11	1	G3	CARRIAGE MANAGER CONNECTOR FOR KEY, EPO SWITCHES
JPC12	1	G6	CARRIAGE MANAGER CONNECTOR FOR SIDEGATE SWITCHES, STEER INPUT ENCODER 2
JPC13	1	G4	CARRIAGE MANAGER CONNECTOR FOR CONTROL HANDLE
JPH3	1	B5,C5	WARNING LIGHT CONNECTOR
JPH4	1	B5,C5	WARNING LIGHT CONNECTOR
JPH5	1	B5,C5	BRAKE CONNECTOR
JPH6	2	D4	TRAVEL SPEED ENCODER CONNECTOR
JPH7	1	E5	STEER FEEDBACK ENCODER CONNECTOR
JPH8	2	B6,C6	BIN LIGHT CONNECTOR (OPTION)
JPH9	2	B6,C6	BIN LIGHT CONNECTOR (OPTION)
JPH11	2	A2,A3	TRACTOR MANAGER CONNECTOR FOR COLD STORAGE HEATERS
JPH12	2	B2,B3	CARRIAGE MANAGER CONNECTOR FOR COLD STORAGE HEATERS
JPH13	2	B3,C3	INTERFACE CABLE CONNECTOR FOR DEADMAN HEATER (OPTION)
JPH14	2	A2,B2,B3	INTERFACE CABLE CONNECTOR FOR CONTROL HANDLE HEATER (COLD STORAGE OPTION)

Figure A-8. Elec. Schematic, Legend, Part 1 of 2